Interactive Systems for Performance: Sound, Sensors, and Real-Time Media

Instructor: John MacCallum, PhD

Level: Undergraduate / Graduate (cross-listed)
Format: Studio / Lab
Prerequisites: None (experience with sound, movement, or programming helpful but not required)

Course Description

This course explores how sound, sensors, and human movement form real-time performance systems. We will work with microphones, accelerometers, biosensors, and simple computer vision features to place sensors in relation to bodies and materials, treating their signals as part of a dynamic field of interaction rather than static readings to be matched or translated.

Students will develop skills in gesture signal processing, shaping sensor signals into behaviors that support clear, grounded, and responsive sonic outcomes. Throughout the course, emphasis is placed on building and refining relationships—temporal, physical, and sonic—through iterative testing.

A significant component of the work involves responding to real performance conditions: noise, drift, unstable signals, shifting patterns of movement. Students will learn to diagnose issues quickly, make adjustments in the moment, and refine their systems through rehearsal and close listening.

Assignments progress from small interaction studies to a larger performance system presented publicly at the end of the term. Students may perform their own work or collaborate with movers.

Approach

The course emphasizes hands-on experimentation and iterative testing. Students will build small interaction systems, observe how they behave with bodies and materials, and refine them through rehearsal. Throughout, we pay attention to how sound and action shape one another in specific situations, and to how systems change as they are used.

By the end of the course, each student will have an interactive setup they understand well enough to keep working with beyond the term—whether that means performing it, adapting it, or folding parts of it into future projects.

Learning Goals

By the end of the course, students will be able to:

- Work with a range of sensing approaches—including audio, inertial, contact, biosignal, and simple computer vision—to develop responsive relationships between bodies and sound.
- Apply gesture signal processing techniques to shape sensor data in real time.
- Develop sonic behaviors that arise from relational interaction rather than fixed one-to-one correspondences.
- Iterate and refine interactions through rehearsal, testing, and close listening.
- Work effectively under real-world conditions, adjusting systems quickly and confidently.
- Organize and document their systems so that they can be understood, adapted, and performed by others.
- Present an interactive performance system that demonstrates clarity, responsiveness, and coherence.

Course Structure — Thematic Units

1. Interaction: Sound, Action, and Attention

- A brief survey of interactive performance practices.
- Listening as a tool for design.
- Exploring how patterns of action and sound can emerge together in interaction.
- Early studies using simple sensors and sound processes.

2. Sensors: Signals, Materials, and Responsiveness

- Audio as a sensor (onset, energy, filtering).
- Accelerometers/IMUs: orientation, acceleration, drift.
- Contact and pressure sensors.
- Biosensors (e.g., heart rate, EMG, MMG): signals and meaning.
- Basic computer vision features for motion and presence.
- Working with noise, latency, and unpredictable conditions.

3. Gesture Signal Processing

- Filtering, smoothing, and differentiation.
- Identifying initiation, sustain, and release.
- Windows, thresholds, and event detection.
- Working with temporal patterns that let gesture emerge across multiple systems at once.
- Building small interaction etudes from processed signals.

4. Relational Interaction: From Signals to Sonic Behavior

- Designing interactions through temporal and physical relationships.
- Shaping sound through changes in pressure, acceleration, and presence.
- Continuous vs. event-driven behavior.
- Tuning interactions during rehearsal.
- Working with performers to refine clarity.

5. Sonic Processes for Interactive Work

- Envelopes, triggers, and continuous control.
- Shaping timbre or texture through gesture-driven processes.
- Dynamic range and stability.
- Structuring short, repeatable studies.

6. System Design, Testing, and Presentation

- Separating sensing, processing, and sound layers.
- Designing for rehearsal and performance.
- Rapid troubleshooting strategies.
- Documentation and organization.
- Preparing a performance system for public showing.

Assignments & Evaluation

Weekly Interaction Studies — 30%
Small exercises focused on specific techniques in sensing, gesture signal processing, or sonic behavior. These studies form the foundation for more developed work.

Midterm Prototype — 20%
A short interactive system (60–120 seconds) that demonstrates:

- a clear sensing approach,
- responsive sonic behavior,
- refinement through rehearsal.

Students may perform their own work or collaborate with movers.

Final Project — 40%
A performance-ready interactive system presented publicly. Possible formats include:

- solo performance,
- a system designed for another performer,
- interactive installation elements.

Participation and Engagement — 10%
Attendance, active involvement in discussions, critiques, readings/listenings, and studio work.

Readings & Listenings (Sample Selections)

Short excerpts will be assigned throughout the semester from authors such as:

- Sha Xin Wei (on materiality, improvisation, distributed agency)
- Stamatia Portanova (on movement, signal, and gesture)
- Erin Manning (on relational movement and attention)
- MacCallum & Naccarato (on relational performance systems, biosensing, and entrainment)
- Artists and researchers working in interactive performance and sound.
- Light technical readings on gesture processing and sensing methods.
- Selected performance excerpts illustrating interactive approaches.

Selections prioritize contemporary perspectives, diverse voices, and accessible entry points into embodied and interactive practice.

Tools & Materials

- **Sensors:** microphones, IMUs, contact sensors, optional biosensors.
- **Software:** environment of choice (Max, Python, pd, TouchDesigner, etc.).
- **Hardware:** laptop, headphones; optional microcontrollers or cameras.
- **Spaces:** studio/lab; optional movement space for testing.

Examples in the course will primarily use Max. Students who wish to use another environment may do so in consultation with the instructor, provided they have sufficient familiarity with that tool. Students without a strong preference are encouraged to work in Max so that in-class support is readily available.